IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ATTY.'S DOCKET: YESHURUN=3A

In re Application of:	)	Art Unit: 1771
	)	
Yehoshua YESHURUN et al	)	Examiner: U. RUDDOCK
	)	
Appln. No.: 09/904,585	)	Washington, D.C.
	)	
Filed: July 16, 2001	)	Confirmation No. 3898
	)	
For: LIGHTWEIGHT ARMOR AGAINST FIREARM PROJECTILES	)	November 30, 2005

DECLARATION UNDER 37 CFR §1.132

I, Yehoshua Yeshurun of 17 Avshalom Street, Haifa, Israel, declare that:

I am a senior scientist at the Ballistic Center in Rafael Ltd. (Armament Development Authority). My academic record includes the following degrees:

- B.Sc. in Mechanical and Materials Engineering from Ben-Gurion University, Israel, (1979);
- M.Sc. in Materials Engineering from Technion Israel Institute of Technology, Israel, (1983);
- D.Sc. from the Department of Materials Engineering at the Technion Israel Institute of Technology, Israel, (1988).

I am one of the inventors of the invention disclosed in US patent application no. 09/904,585 (hereinafter "the application").

Regarding the stated reference of Fischer *et al*, it is my opinion that a person skilled in the art of armor manufacture would understand that a "first ply, which is disposed in the direction of an expected impact" refers to a ply facing the expected impact, i.e. in a laminate consisting of a plurality of plies the ply "disposed in the direction of an expected impact" is the ply first impacted by an oncoming projectile.

Fischer consistently uses the word "dispose" in this manner, for example:

- "adhesive layer disposed therebetween" (col. 1, line 16)
- second ply, which is disposed behind the first ply" (col. 1, line 65)
- third ply, which is disposed behind the second ply" (col. 2, line 1)
- forth ply, which is disposed behind the third ply" (col. 2, line 52)
- fifth ply, which is disposed behind the fourth ply" (col. 2, line 54)

Furthermore, Fischer must teach which ply faces the expected impact as it states in the reference: "The results show that the order of the laminate's successive plies is important in achieving good ballistics performance" (col. 13, line 4) and that the "respective first, third and fifth plies have a uniform thickness in a proportion of about 2:4:1" (col. 13, lines 48-50 and col. 14, lines 65-67). As the thickness of the first, third and fifth plies differ, the reference, according to Fischer's aforementioned statement regarding "order", must specify which ply faces

the expected impact else a person skilled in the art would be lacking the information as to in which orientation to install the laminate. Therefore, Fischer teaches the "first ply, which is disposed in the direction of an expected impact" to specify which ply faces the expected impact.

The remainder of the reference further supports this understanding of the phrase "disposed in the direction". This is seen from the experimental examples given and accompanying test result criteria. In the examples given for the laminate's ballistic response, the experiments were performed under standard test conditions "specified in the Underwriters' Laboratories Class II method" (Col. 5, lines 47-49) and "Class III method" (Col. 10, lines 24,25). These standard tests are normally performed with the armor disposed perpendicular to projectile line of flight unless specifically indicated otherwise, which is not seen to be the case in Fischer.

Furthermore, it is clear that a person skilled in the art could not understand Fischer to be teaching a first ply of PMMA in an orientation different to that of the subsequent plies. This is because the reference consistently teaches the invention as one integral piece, for example:

- "Impact resistant laminate" (Patent title, first line of abstract). The word laminate is understood to mean an integral structure with parallel plies.

- "The laminate has a substantially better ballistic response" (col. 2, line 12). The word laminate is found consistently and repeatedly throughout the specification.

- each ply is "immediately behind" (e.g. col. 13, line 34) the preceding ply, further teaching a integral structure.

- every figure in the reference supports the view that Fischer teaches an integral structure with parallel plies.

Therefore, according to the possible understanding that the first ply is inclined or slanted, by the words "disposed in the direction of an expected impact", it would necessarily follow that the entire laminate is inclined or slanted. The difficulty raised with this understanding of Fischer being that if the entire laminate is slanted or inclined and each ply is parallel and integral to each other then it makes no sense for Fischer to specify **only one ply** as being slanted or inclined, and not to specify the entire laminate. Therefore the only logical understanding of "disposed in the direction of an expected impact" is that Fischer is teaching that the first ply is the ply facing the expected impact.

In summary of the above argument, Fischer does not teach a slanted or inclined first ply. Furthermore, a person skilled in the art would not learn from Fischer that the use of a PMMA ply, in isolation of the combination of plies taught in the reference, provides a ballistic response that is unexpectedly high, as will be explained below.

Fischer consistently teaches the use of a laminated armor configuration which requires the first ply of PMMA in conjunction with other plies consisting of different

materials in an order specified in the reference. This is indicated by the following statements:

- "in accordance with the invention, the laminate includes at least three transparent plies" (col. 1, line 59)
- "The three plies cooperate to provide a ballistic response that is unexpectedly high" (col. 3, line 22)
- "the laminate has a substantially better ballistic response than any one of the three materials by itself…"(col. 2, line 10)
- "The results show that the order of the laminate's successive plies is important in achieving good ballistics performance." (col. 13, line 4)

Therefore, a person skilled in the art would learn from Fischer that only by using a PMMA ply with the combination of plies taught in the reference would provide a ballistic response that is unexpectedly high.

The stated need for the combination of plies in Fischer demonstrated that the advantageous properties of a PMMA layer alone had not been realized.

Furthermore a skilled person could not learn from Fischer an armor configuration for the prevention of penetration from a high threat level projectile, such as an armor piercing (AP) projectile. In all of the examples given in Fischer only low threat level projectile types are specified, such as:

- "soft point projectile" (col. 5, line 45)
- "lead point" (col. 7, line 26; col. 10, line 16)
- "fragment-simulated projectile (FSP)" (col. 8, line 13; col. 11, line 65; col. 12, line 59)

During our experiments on various brittle materials it was found that when epoxy resin and PMMA are impacted by an armor piercing (AP) projectile, they may act on the projectile in a manner different from other tested brittle materials. Namely, the experiments showed that under certain conditions, inclined targets with epoxy resin or PMMA material at their front, surprisingly caused the projectile to ricochet from the target after having been yawed thereby (i.e. rotated within the material), whereby the projectile's penetration through the material was prevented. Such a possibility is mentioned in the article "Ricochet of 0.3" AP projectile from inclined polymeric plates"(see page 222, final paragraph continuing onto next page). Consequently, PMMA and epoxy resin appear to be capable of providing better ballistic performance than other brittle materials, notwithstanding the fact that they are of lower density and hardness then other substances we have experimented with.

Computer simulations showed the same results and these simulations and their comparison to experimental results are summarized in the article cited above, a copy of which is enclosed herewith as annex A.

The experiments and simulations show that for the desired effect of maximizing the asymmetric interaction between an armor layer and the projectile, the slanted layer must have high dynamic compressive strength, high brittleness and low density (page 224, final paragraph). Therefore PMMA and epoxy resin are currently the most suitable materials for utilizing as a slanted armor layer.

In addition, tests were performed on PMMA plates of different thicknesses, slanted at different angles. During the test a projectile was fired, in this case a 7.62x39 API BZ (AK47, armor piercing) bullet with an impact velocity of 720m/s, at a PMMA plate.

It was found that the best result was produced when the PMMA layer was oriented at an angle of obliquity of 60 degrees to the projectile line of flight. In that case a plate thickness of about 20mm was sufficient to prevent the projectile from penetrating through the plate. Whereas, firing the same projectile under the same conditions at a PMMA plate that was oriented perpendicular to the projectile line of flight, a plate thickness of not less than about 110mm was necessary to prevent the projectile from penetrating through the plate.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with knowledge that willful false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: November ____, 2005 _____

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